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# ENVIRONMENTAL Fact Sheet

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29 Hazen Drive, Concord, New Hampshire 03301 • (603) 271-3503 • [www.des.nh.gov](http://www.des.nh.gov)

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## Disinfecting a Private Well

The following provides a detailed, step-by-step outline for emergency disinfection of a private drinking water well. It is possible to have good disinfection even though certain steps are deleted. It is also possible that some water supplies may be prone to bacterial contamination and thus require permanent disinfection.

### ACTIONS PRIOR TO DISINFECTION

**Well Inspection.** Carefully inspect the well to identify potential pathway(s) that allowed bacteria to enter the well. See the DES fact sheets concerning Dug Well Design at [www.des.state.nh.us/factsheets/ws/ws1-4.htm](http://www.des.state.nh.us/factsheets/ws/ws1-4.htm) or Bedrock Well Design at [www.des.state.nh.us/factsheets/ws/ws1-2.htm](http://www.des.state.nh.us/factsheets/ws/ws1-2.htm), which identify good well construction. If there are structural deficiencies in the well that are not addressed, the bacteria **contamination will reoccur**. The vast majority of bacterial occurrences in wells can be linked to easily corrected construction flaws rather than disaster conditions.

**Flushing the System.** The second step prior to disinfecting is to flush the well and the home's plumbing the system. Chlorine is not able to kill bacteria entrapped within mud, rust or other solids. In order to achieve total bacterial kill, all components of the system must be flushed to a clean condition. Flush this debris through outside hose taps so as to not overload your septic tank or leach field. Also bypass any treatment devices until discussing disinfection with the treatment device installer or manufacturer.

**Cleaning/Flushing Dug Wells.** Slide open the cover, look for poor construction and repair as necessary, scrub the walls with a long handled brush and wash down using a garden hose. If a "mud sucker construction pump" is available, pump the dirty water out of the well. If only the regular installed pumping system is available, pump the dirty water out of the well using outside sill faucets of the home. During this flushing process, do not use water in the home in order to minimize the amount of dirty water entering the rest of the plumbing system. Flush the well to a clean condition until all discolored water has ceased. Be careful no to overheat the pump.

**Cleaning/Flushing Bedrock Wells.** It is not possible to physically clean the side walls of a bedrock well. However, the cascading water caused by the "drawdown" in the well will significantly flush the inside of the well. Flush the well by pumping to waste until all discoloration has ended. If the pumped water becomes mixed with air, turn off the pump so as to not to cause overheating and pump damage. Pumping can continue later.

**Flushing Pressure Tanks.** Settling of dirt may occur in the pressure tank and/or hot water tank of the plumbing system. To clean the pressure tank, first run the well until the water coming out of faucets is crystal clear over a sustained period. Then using the manual off/on switch and automatic pressure switch, create flow in and out of the pressure tank to loosen any sediments that has settled to the bottom of that tank. For cleaning the hot water tanks connect a garden hose to the faucet at the bottom of the tank and flush to waste until clean.

**Flushing Plumbing.** The plumbing system can be cleaned by creating high flow velocity in the plumbing. This can be accomplished by targeting each leg of the plumbing system separately. Best results are achieved by opening multiple faucets to create the highest flow rates possible. The velocity of flow (i.e., high flow), rather than the flow duration, is the most critical factor in flushing the plumbing. Flush this cleaning water onto the ground, not into your septic system, where possible. Remove faucet aerators before flushing.

## WHAT CHEMICALS TO USE TO DISINFECT

Chlorine is the standard chemical used to disinfect all components of a water system except treatment devices. For disinfecting treatment devices call your water conditioning installer or manufacturer. Chlorine comes in two common forms: 5.25-6 percent sodium hypochlorite, a liquid; and 70+ percent HTH calcium hypochlorite, a solid. The liquid form is ordinary household chlorine bleach., however, read the small print on the label to ensure that it is only sodium hypochlorite. The solid HTH can be purchased from swimming pool supply dealers in either tablets or powder form. Do not use modern bleaches made for synthetic fabrics or those with fragrances added for disinfecting a well.

## ESTIMATING THE VOLUME OF WATER NEEDING DISINFECTION

To determine the amount of chlorine to use, it is necessary to first estimate the total volume of water to be disinfected. This would include the water in the well, that in surrounding soils, and that in the home's plumbing system. The volume of water in a cylindrical shape can be determined by using the formula below:

$$\text{Volume (in Gallons)} = n \times R^2 \times H \times 7.48$$

Where:  $n = 3.14$

$R$  = radius (in feet) of the well.

$H$  = water depth (in feet) from water surface to bottom of the well.

Shown below are volumes for various size cylinders. Bedrock wells are typically 6" in diameter and dug wells are typically 3 feet in diameter.

### VOLUME IN WELLS

(Approximate capacity of a well in U.S. Gallons)

Diameter	6"	1'	2'	3'	4'	
Water Depth						
2.5'*	4	15	60	130	230	gallons
5'*	8	30	120	260	460	
10'	15	60	240	520	930	

20'	30	120	470	1060	1880
100'	140	590	2350	-	-
500'	710	2950	-	-	-

\* = to achieve minimal filtration of rainfall, the soil backfill around a well should be at least 5 feet above the seasonal high water table.

Water also exists outside of the well hole in the soil and crushed stone or rock fractures surrounding the well. Depending on well type and depth, this amount of water can be large. We suggest doubling or tripling the volume of water determined inside the well casing when considering the amount of well water needing disinfection. Your estimate of the amount of extra water outside the well's "footprint" is a judgment call.

## CONCENTRATION OF CHLORINE TO USE

**Liquid Chlorine.** The chlorine concentration used to disinfect a well can be varied based on the bacterial contamination level expected. If the well is believed to be reasonably clean (no inundation by muddy surface water, no dead animals), then 5-10 parts per million (ppm) is a good disinfecting concentration. If stronger contamination is expected, then a 50 ppm concentration, or higher, should be used. Shown below are amounts of chlorine to achieve the desired concentration of chlorine in water. Chlorine can be hazardous; wear suitable clothing and eye protection.

Desired Chlorine and Water Concentration	5.25-6% Chlorine Store Bleach	Water Volume
1 ppm*	1 gallon of 5.25%	50,000 gallons
5 ppm	1 gallon of 5.25%	10,000 gallons
10 ppm	1 gallon of 5.25%	5,000 gallons
50 ppm	1 gallon of 5.25%	1,000 gallons

\*parts per million also equal to milligrams per liter

**Example:** Assume we have a well 800 feet deep, 6 inches in diameter and static water at 50 feet. Your calculations of the amount of water needing to be disinfected is given below:

$$\begin{array}{rcl}
 \text{Water inside well whole} & = & 1,100 \text{ gallons} \\
 \text{Water in rock/soils immediately surrounding well hole} & = & 2,200 \text{ "} \\
 & & (\text{assume twice as much volume}) \\
 \text{Water in home plumbing and pressure tank} & = & 50 \\
 \hline
 \text{Total} & = & 3,350 \text{ gallons}
 \end{array}$$

Now choose the concentration of chlorine to be used, based on assumed contamination level. Since the well has been flushed to a high state of cleanliness, use 10 ppm of hypochlorine for the disinfection solution. Refer to the chart above and select the line, for the desired concentration of 10 ppm, i.e., second line for 10 percent.

Since we only have approximately 3,400 gallons of water to disinfect at a desired concentration of 10 ppm, we will not need a full gallon of bleach. Given 3,400 gallons of water to disinfect, the amount of bleach is given by the ratios of water volumes 3,400/5,000. This would be approximately 3 quarts of bleach solution.

#### Solid Chlorine

Equivalent Volume of Hypochlorite to Weight of HTH	
Required 5.25-6 % Hypochlorite	Equivalent 70% HTH
1 quart	2.2 oz by weight
1 gallon	8.9 oz

In bedrock wells remember there are other homes down hill of your property also using the same rock fractures. Please start with a low concentration chlorine, going to higher amounts if your first disinfection is not successful. Please respect your neighbors.

### DISINFECTING WELLS

Pour in the proper volume of chlorine into the well. Mix by running a hose stream from a sill faucet into the well. Circulate the chlorine water solution through the pressure tank, and home plumbing system. Confirm chlorinated water has reached all taps by odor at user taps or by test kit determination. Chlorine test kits may be owned by those neighbors that have backyard swimming pools.

Let chlorinated water remain in the pipes and well overnight. Some water usage can occur but avoid high volume demands that would dilute the chlorine strength. *Do not drink water with high chlorine levels.*

**Existing Dug Wells.** Remove the cover. Pour in the proper volume of chlorine. Mix using flow from a garden hose and await odor from faucets.

**Existing Bedrock Wells.** Remove or open well cap. Some well caps have a 1-inch removal plug at the top of the cap. This plug can be removed to gain access to the interior of the well. Otherwise remove the entire cap. With bedrock wells there may be difficulty in dispersing the chlorine throughout the entire well depth. When liquid chlorine is used, add water to the top of the well to force the liquid chlorine deeper into the drill hole. Typically a garden hose would be used for mixing the chlorine. The water would be added to the top of well until the chlorine odor is noted in the running water. This method is often used for a shallower bedrock well, less than 100 feet.

Solid chlorine tablets can also be used. The advantage of chlorine tablets is that they sink to the bottom of the well, fully dispersing the chlorine through the overall well depth. The tablets should be reduced in size by placing in a heavy bag and breaking with a hammer. Pour the dry chlorine pieces into the well. Wash chlorine particles off wires and other well parts of the well interior. Liquid chlorine can also be used in a deeper well.

Let the chlorine set over night, and then proceed as indicated for shallow wells.

### HOW TO TIME THE ADDITION OF CHLORINE

As a typical rule of thumb, the chlorine should be in contact with the water system components overnight. The more contact time, the more assured the bacterial kill. Chlorine is normally added to a water system in the early evening. This allows the chlorine ample contact time with the well before being flushed out the next morning. Early the next morning, the excess chlorine should be flushed to waste. DES suggests flushing to waste until the free chlorine level is less than 1.0 mg/l free chlorine. The remaining chlorine will dissipate with time and usage.

### **Flushing out Chlorine**

The next morning flush the heavy chlorine to waste into the woods or on top of the soil. Do not run the chlorine solution into a stream as it will kill fish, frogs, etc. Do not run chlorinated water into leach fields or onto grass. Continue until chlorine has dissipated or is of a very low concentration. Remember no bacterial testing can begin until all chlorine is gone. Chlorine will dissipate on its own with time. Flushing chlorine to waste hastens the process.

### **WATER QUALITY TESTING**

Once all chlorine is purged from the well, a bacterial test can be taken. **Any** chlorine remaining in the well or in the sample bottle will negate the lab test thus requiring collection of another sample. Thus *all chlorine must be purged from the well before a bacterial test can be taken.*

If the bacterial test shows the absence of total coliform bacteria the well should be useable for drinking water. However if there is not a good bacteria sample record for this well it is desirable to take a few more bacterial samples to document the consistency and dependability of the acceptable bacterial condition.

If total coliform is present or occurs irregularly, it may mean that the disinfection needs to be done over or it may mean that new bacteria have entered the well from an unrecognized defect that caused the previous bacterial contamination.

### **Permanent Disinfection**

If bacterial presence continues, a permanent disinfection system should be installed. Such system could be a chlorine feed by a chemical feed pump or an ultraviolet (UV) system as discussed in fact sheet [www.des.state.nh.us/factsheet/ws/ws-4-5.htm](http://www.des.state.nh.us/factsheet/ws/ws-4-5.htm). Such a system should be preceded by a fine mesh particle filter to insure the disinfectant is not overwhelmed by irregular contaminant levels. If there has been no meaningful bacterial testing on this source in recent years, it may be possible that the well did not have reliable bacterial even before the emergency condition.

### **FOR MORE INFORMATION**

For more information, please call DES at (603) 271-3503. For a complete list of fact sheets please request fact sheet WD-WSEB-15-2. We would appreciate your comments and suggestions pertaining this fact sheet. Drinking water fact sheets are available through the DES web site at: <http://www.des.nh.gov/wseb> then select fact sheets. Please check with the DES internet site annually for changes to this document. 10/05